- 1 AUTONOMOUS STORAGE FOR BACKUP, RESTORE, AND FILE ACCESS
- 2 FIELD OF THE INVENTION
- The present invention relates to methods and apparatus
- 4 to provide secure autonomous storage for backup,
- 5 restore, and file access.

BACKGROUND OF THE INVENTION

- 7 There is a considerable amount of prior art in the of
- 8 field of backup and restore systems. Several well-known
- 9 backup and restore systems are currently marketed by
- 10 companies such as Veritas and IBM. These systems
- 11 provide reliable, secure backup and restore
- 12 capabilities by utilizing a server that contacts each
- 13 registered client in turn to request to a backup
- 14 session. The client system generally has an agent
- installed that communicates with the backup server, and
- 16 together the backup server and client agent negotiate a
- mutually acceptable arrangement for performing the
- 18 backup. The server might contact the client and tell
- the client that it will be available in the next half
- 20 hour to perform a backup of the client, and ask if the
- 21 client can agree to that schedule. If so, the client
- 22 waits to be contacted by the server and makes
- 23 preparations for the backup if required.
- 24 These backup systems usually require a server and one
- or more clients. The server oversees the operation and
- 26 provides the storage for the backed up files. In
- general, the clients are polled to provide their backup
- 28 data to ensure that the server has the capacity to

- 1 perform the backup at the specified time, with backup
- 2 performed at the convenience of the server, and not the
- 3 client(s). In order to complete the backup, however,
- 4 the client system must be connected to the network at
- 5 the same time the backup server is available or the
- 6 backup cannot be completed.
- 7 For traveling users, getting their system backed up can
- be a chore. In order to get backed up, the client
- 9 system must be on the network until contacted by the
- 10 backup server. It is likely that a traveling user's
- 11 system will never be connected at the very moment that
- 12 the server gets around to backing it up.

13 SUMMARY OF THE INVENTION

- 14 It is therefore an aspect of the present invention to
- provide for secure and automatic backup of client data
- even if the client system is not always connected to
- 17 the network or the backup server.
- 18 It is another object of the invention to provide such
- backup in a manner that is virtually transparent to the
- 20 user.
- 21 The present invention provides for the on-demand backup
- of the client system programs and data by using a
- 23 storage device and storage management software which is
- 24 preferably located in the client system's docking
- 25 station. However, although this invention is described
- 26 herein as being located in a local docking station
- 27 device, the storage portion of the invention can be

located anywhere in the network provided that it is accessible from both the client system and the server.

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The invention, is directed to a method, a system and a computer program product (software) for implementing the method and system. For example, in a system having a client computer, and apparatus for connecting the client computer to a network having a server for backing up the client computer, the invention directed to a method for transferring data from the client computer to the server, comprising connecting the client computer to the network; backing up data on the client computer to a storage device attached to the network when the client computer is connected to the network; and transferring the data from the storage device to the server. The transferring of the data from the storage device to the server occurs at a time The connecting may comprise determined by the server. connecting the client computer to a docking station connected to the network. The storage device may be associated with the docking station.

The method may further comprise connecting the client computer to the network a plurality of times before the server backs up the data on the client computer, and creating a new data set on the storage device for transfer to the server each time the client computer is connected to the network. The data sets are transferred to the server in the order in which the data sets were created.

1 may comprise establishing connecting 2 transfer link between the client computer and the data 3 storage device. The data transfer link may comprise one of a wireless link and an infrared link. 4

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If the client computer is off when connected to the network, the method further comprises powering up a 7 storage device in the client computer; and transferring data stored on the storage device in the client computer to the storage device attached to the network. If power to the client computer is turned on during transfer of data stored on the storage device in the client computer to the storage device attached to the network, the transfer of data is suspended while the If the client computer is client computer boots up. initially on when connected to the network, but the client computer is turned off, the method further comprises suspending transferring data stored on 17. storage device in the client computer to the storage device attached to the network, to permit normal backup of files on the client computer. If the client computer is disconnected from the network during a first backing up of data on the client computer to a storage device attached to the network, and the client computer is again connected to the network, the client computer is backed up to the storage device on the network a second time, and data is sequentially transferred in the following order: first data transferred to the storage device before the client was disconnected from the

- 1 network, and then data transferred to the storage
- 2 device during the second time.

- 4 BRIEF DESCRIPTION OF THE DRAWINGS
- 5 These and other aspects, features, and advantages of
- 6 the present invention will become apparent upon further
- 7 consideration of the following detailed description of
- 8 the invention when read in conjunction with the drawing
- 9 figures, in which:
- 10 Fig. 1 is a block diagram of a system in accordance
- 11 with the present invention.
- 12 Fig. 2 is a flow chart of a data back up process when
- the client is connected to network.
- 14 Fig. 3A and Fig. 3b are flow charts of the data backup
- operation for multiple connections of the client to the
- 16 network.
- Fig. 4 is a flow chart of backup to a server.
- 18 DESCRIPTION OF THE INVENTION
- 19 Variations described for the present invention can
- 20 be realized in any combination desirable for each
- 21 particular application. Thus particular limitations,
- 22 and/or embodiment enhancements described herein, which
- 23 may have particular advantages to the particular
- 24 application need not be used for all applications.
- 25 Also, it should be realized that not all limitations

- 1 need be implemented in methods, systems and/or
- 2 apparatus including one or more concepts of the present
- 3 invention.

4 Referring to Fig. 1, in a computer network 100, many 5 computer users utilize the same computer (shown as 6 client system 102) at the office as they do when 7 traveling. This is made easier by devices called 8 docking stations 103. A docking station is a unit that 9 contains connectors, plugs, and jacks necessary to hook 10 the client system 102 up to the network 100 11 optionally to a server 101), a separate monitor (not 12 shown), a mouse 106, a separate keyboard (not shown), 13 and other devices. These devices plug directly into 14 the docking station 103, and the client system 102 15 snaps into the docking station. The docking station 103 16 connects the client system 102 electrically to the 17 proper devices and connectors attached to the docking 18 station 103. The client system 102 usually connects to 19 the docking station through some type of recessed 20 connector that is exposed only when the client system 21 102 is plugged into the docking station. Those skilled 22 in the art can appreciate that there are many ways that 23 a client system can be connected to a docking station. 24 A recessed connector is cited herein as an example of 25 how some docking stations are constructed. Using a release button or release mechanism on the docking 26 27 station 103, the client system 102 can be removed from 28 the network 100 and external devices by simply lifting 29 it from the docking station 103. Thus, the user is not

- 1 required to remove plugs and jacks from the client
- 2 system 102 to disconnect it from external devices or
- 3 the network 100.

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- 4 Traveling users come and σo from the office 5 They may visit the office in the morning environment. 6 or in the evening to replicate mail, calendar, and 7 other information. Often, once the requested data 8 transfer has been completed, they remove the client 9 system 102 from the docking station 103 and leave to 10 visit customers. In this scenario, however, the client 11 system 102 often never gets properly backed up. 12 chance that the client system 102 is connected to the 13 network at the very time the backup server 101 needs to 14 do a backup is very slim. For this reason, it is 15 better to do backup "on demand" when the customer needs 16 it, at the convenience of the client, not at the 17 convenience of the server as is done in current backup products. 18
 - In accordance with the invention, in the docking station 103, a small interface board 106, having a small processor 108, and a disk drive or other storage device 104 are installed, although in practice, these components may be installed anywhere on the network. The storage device 104 also may be a flash memory, an internal disk drive, an external disk drive, a storage card, or any other device capable of storing digital data. In one implementation of the present invention, the storage may also exist on the network interface adapter.

1 When the user places the client system 102 on the docking station, the action of attaching or connecting 3 the client system 102 to the docking station 103, causes the storage device 104 to wake up and do an immediate backup of the client system 102. The storage device 104 may be powered from an external source, but may also be powered from the internal power supply (typically a battery) of the client system 102.

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- While the invention has been described above with respect to placing the client computer 102 in the docking station 103 in order to transfer data, the invention does not require an actual physical coupling. and a docking station need not be used. Data may be transferred by wireless connection (including a short range link), infrared link, or any other means, form a client computer to a back up storage device on a network capable of storing data until it is backed up by a server. Preferable, the connection between the client computer and the backup device uses some type of encryption or other security means to ensure that the data remains confidential.
 - Referring also to Fig. 2, if the client system 102 is off when the user places it on the docking station 103 (step 200 Fig. 2), the processor device and of associated hardware of the present invention cause the disk drive (not specifically shown) of the client system 102 to power up 202, utilizing either the power from the docking station 103 or from the battery of the

- 1 client system 102. The interface board of the present
- 2 invention 106 then commences to facilitate a very fast
- 3 copy from the client system 102 to the storage unit 104
- 4 located in the docking station 103 (step 203 of Fig. 2)
- 5 or some other location in the network.
- 6 If the client system 102 is already powered on, the
- 7 interface board 106 commences to facilitate a very fast
- 8 copy 203 from the client system 102 to the storage unit
- 9 104 located in the docking station or in some other
- 10 location in the network.
- In accordance with the invention, if the client system
- 12 102 was powered down, the disk drive of the client
- 13 system is turned off once again at 205.
- 14 If power to the client system 102 is shut off during a
- backup operation, the software of the present invention
- continues autonomous backup of the client files at 203.
- using the interface board 106 in the docking station
- 18 **103**.
- The data from the client system 102 is backed up to the
- 20 storage device 104, and the user can continue to use
- 21 the system normally while the backup is running. The
- docking station 103, which is almost always attached to
- the network, can now respond to the backup server 101
- 24 at any time, day or night, and it does not matter
- whether or not the client system 102 is powered on.
- The backup server 101 instead communicates directly
- with the processing interface board 106 and the storage
- device 104 in the docking station 103, and can now be

- 1 backed up at the normal server schedule. When
- 2 communicating with the docking station 103, the backup
- 3 server 101 operates as if it were communicating
- 4 directly with the client system 102, and has no
- 5 indication that it is instead communicating with the
- 6 docking station 103.
- 7 It is important to note that two distinct backups take
- 8 place using the present invention. The first backup is
- 9 the backup that takes place between the client system
- 10 102 and the processor and storage of the present
- invention. The second backup takes place between the
- 12 server and the docking station.
- 13 If the docking station contains no data (the client has
- 14 never been backed up) a backup is first done from the
- 15 client to the storage device and processor of the
- 16 present invention, then the normal backup done between
- 17 the server and the docking station. As far as the
- server is concerned, it is doing a normal backup to the
- client, when in reality, it is actually doing a backup
- of the storage of the present invention.
- 21 It is possible that in certain circumstances the
- 22 connection of the client computer to the network may be
- 23 interrupted during local backup of the client computer
- 24 to the storage device associated with the docking
- station. While a fast copy routine will tend to
- 26 minimize the likelihood of this happening, there are
- 27 several measures that may be taken to deal with this
- possibility. In a first case, the user of the client

computer may be prompted with a display indicating that backup is taking place, and that the client computer is to remain connected to the network through the docking station or any other connection being used. In a second case, transfer to the local storage device is suspended as soon as the connection is broken, but a partial data set is saved on the local storage device. Then, when the client computer is again connected to the network, a full data set is saved. When the server is connected for backup to the server, the partial data set and then the full data set are sequentially backed up to the server, in a manner similar to that described above. A specific approach is set forth below.

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Fig. 3A and Fig. 3B deal with the situation in which the client system 102 is placed in the docking station 103 (or connected to the docking station by a data link), but is removed from the docking station 103 (or the data link is severed) and then inserted again before local backup has been completed. Referring to Fig. 3A, if the client computer is removed, a reject request 301 is generated. If a local backup operation is being conducted, a flag is set at 302, and the client computer is ejected (removed) from the docking system at 303. If there is no backup running, the removal or ejection takes place at 304, without setting the flag.

Referring to Fig. 3B, when the client computer 102 is again inserted into the docking station, or a data link is reestablished at 306, the state of the flag is

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- 1 If the flag was not set, local backup is 2 performed at 307 to create a backup data set in the 3 storage device 104 associated with the docking station. 4 Normal operation continue 308. If the flag was set, a 5 new backup data set is created at 309. There are now 6 at least two backup data sets, depending on the number 7 of times that the client computer 102 is connected to 8 the docking station 103 before data is backed up to the 9 server 101.
 - Referring to Fig. 4, eventually, perhaps on predetermined schedule, such as during early morning hours, when a great deal of network traffic is not expected, the server is connected to the station, and backup to the server starts at 400. At 401, a determination is made as to whether there are any data set to back up. If there are none, the backup operation to the server is terminated at 402. If there are data set to back up, the oldest (the data set generated first) is backed up to the server at 403. 404, a determination is made as to whether there are any additional data set to back up. If there are, then operations return to 403 and the next data set is backed up to the server. When all data set have been backed up, as determined at 404, backup operations to the server are terminated, at 405.
- The present invention may also be used to facilitate file sharing or distribution. If a file on a client is placed on a server, it may be made available for general distribution to other users of the server,

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- after being backed up to the server as data. Thus,
- 2 files on the server, whatever their source can also be
- 3 downloaded to selected clients, or to all clients, as
- an adjunct to the backup processes described above.
- 5 The present invention can be realized in hardware,
- 6 software, or a combination of hardware and software.
- 7 Any kind of computer system or other apparatus
- 8 adapted for carrying out the methods and/or functions
- 9 described herein is suitable. A typical combination
- 10 of hardware and software could be a general purpose
- 11 computer system with a computer program that, when
- 12 being loaded and executed, controls the computer system
- such that it carries out the methods described herein.
- 14 The present invention can also be embedded in a
- 15 computer program product, which comprises all the
- 16 features enabling the implementation of the methods
- described herein, and which when loaded in a computer
- system is able to carry out these methods.
- 19 Computer program means or computer program in the
- 20 present context include any expression, in any
- 21 language, code or notation, of a set of instructions
- 22 intended to cause a system having an information
- 23 processing capability to perform a particular function
- 24 either directly or after conversion to another
- language, code or notation, and/or reproduction in a
- 26 different material form.

Thus the invention includes an article of manufacture comprises a computer usable medium having computer readable program code means embodied therein for causing a function described above. The computer readable program code means in the article manufacture comprises computer readable program code means for causing a computer to effect the steps of a method of this invention. Similarly, the present invention may be implemented as a computer program product comprising a computer usable medium having computer readable program code means embodied therein for causing a function described above. The computer readable program code means in the computer program product comprising computer readable program code means for causing a computer to effect one or more functions of this invention. Furthermore, the present invention may be implemented as a program storage device readable by machine. tangibly embodying a program of instructions executable by the machine to perform method steps for causing one or more functions of this invention.

It is noted that the foregoing has outlined some of the more pertinent objects and embodiments of the present invention. The concepts of this invention may be used for many applications. Thus, although the description is made for particular arrangements and methods, the intent and concept of the invention is suitable and applicable to other arrangements and applications. It will be clear to those skilled in the art that other

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effected without departing from the spirit and scope of the invention. The described embodiments ought to be construed to be merely illustrative of some of the more prominent features and applications of the invention. Other beneficial results can be realized by applying the disclosed invention in a different manner or modifying the invention in ways known to those familiar with the art. Thus, it should be understood that the embodiments has been provided as an example and not as a limitation. The scope of the invention is defined by the appended claims.